Building from Proportions to Graphing Linear Relationships in Grades 6-8

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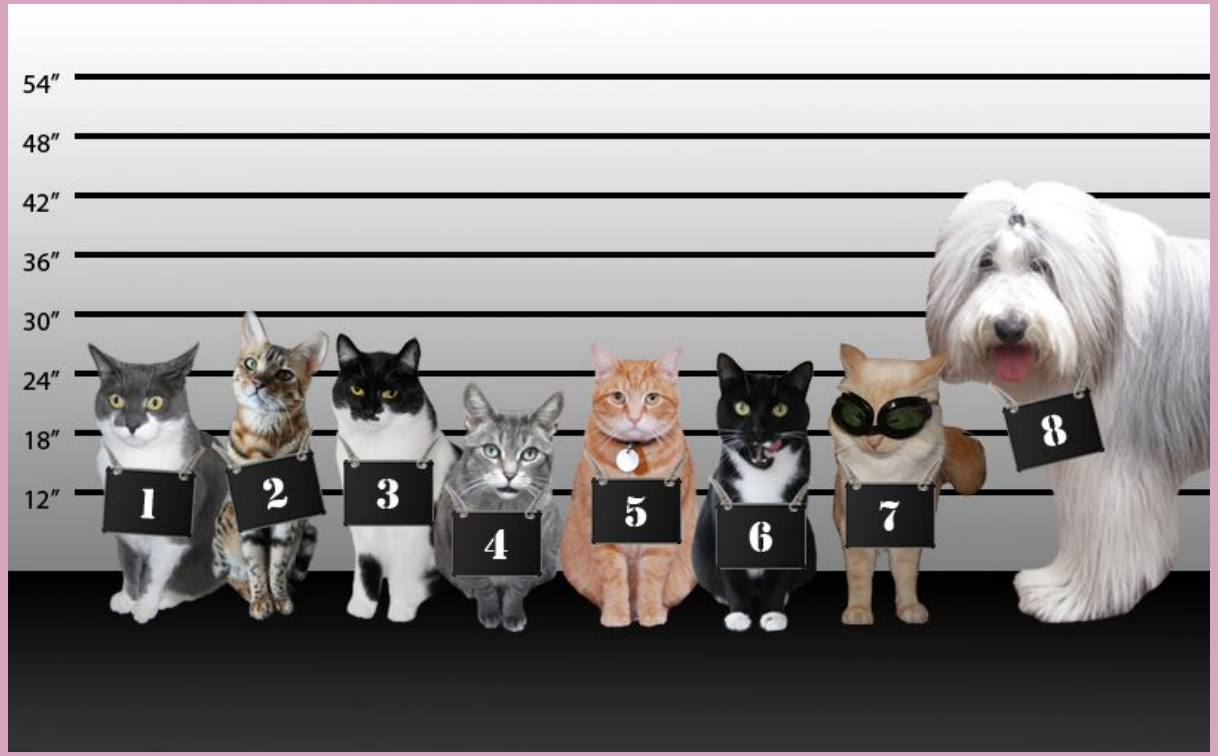
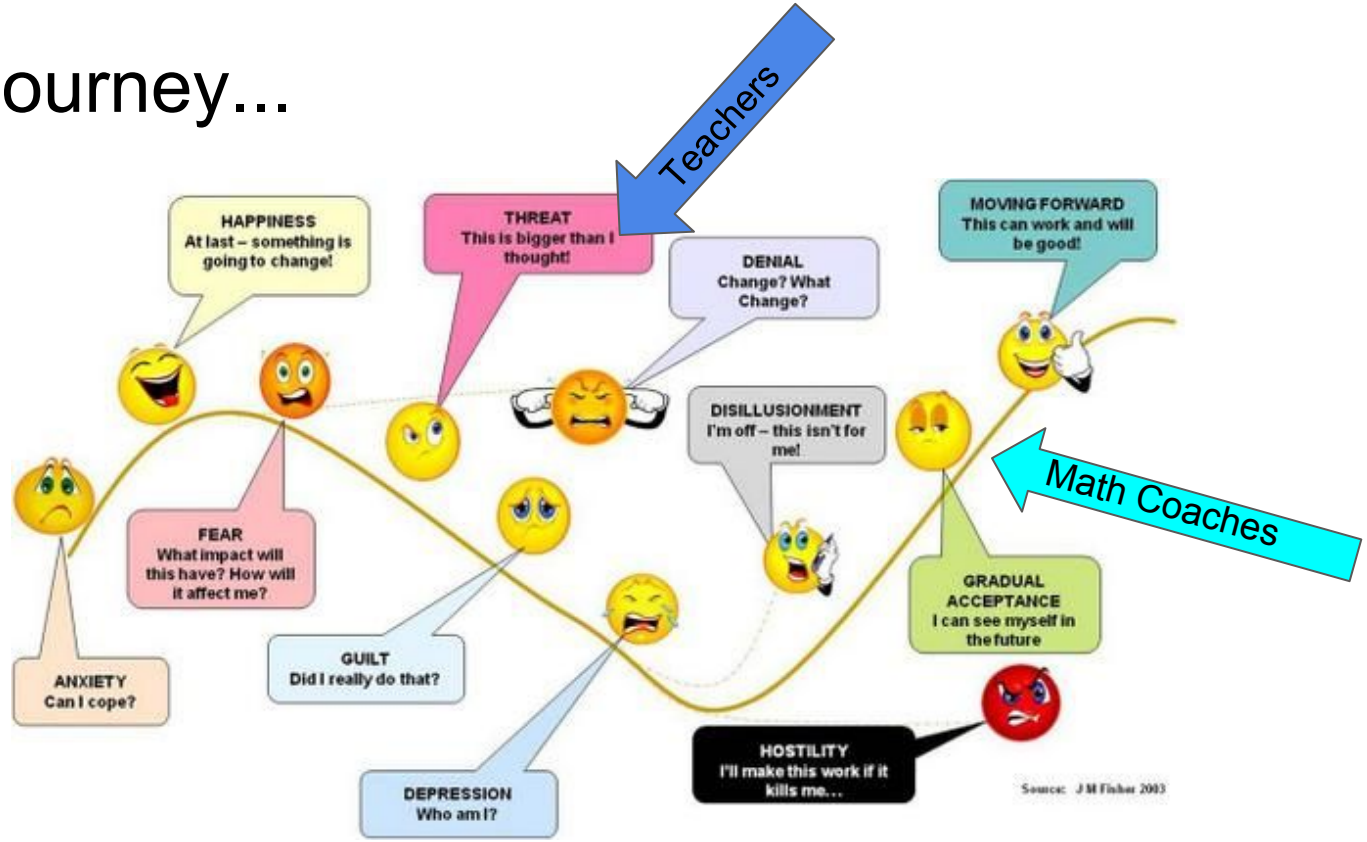
What does the ratio of cats:dogs have to do with $y=mx+b$?



Sharing our journey...



Where are you?

Attended DOE Institute

Reviewed Curriculum Framework

Planning what to share with teachers, when and how

Summer Professional Development

1) Overview
2) Digging Deeper

6.12 The student will

a) represent a proportional relationship between two quantities, including those arising from practical situations;
b) determine the unit rate of a proportional relationship and use it to find a missing value in a ratio table;
c) determine whether a proportional relationship exists between two quantities; and
d) make connections between and among representations of a proportional relationship between two quantities using verbal descriptions, ratio tables, and graphs.

Brainstorm what you think students will be asked to do based on this standard.

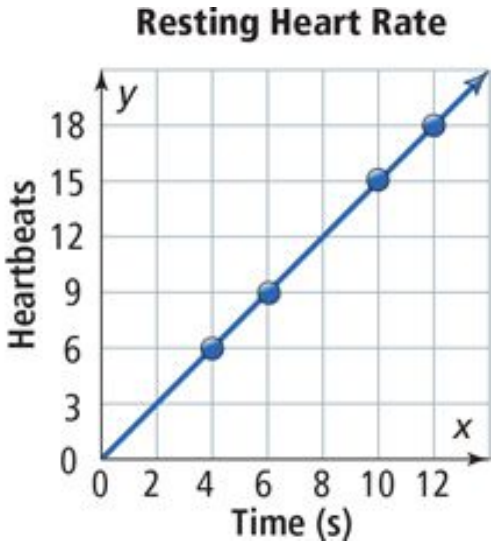
SOL 6.12

Essential Knowledge and Skills

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Make a table of equivalent ratios to represent a proportional relationship between two quantities, when given a ratio. (a)
- Make a table of equivalent ratios to represent a proportional relationship between two quantities, when given a practical situation. (a)
- Identify the unit rate of a proportional relationship represented by a table of values or a verbal description, including those represented in a practical situation. Unit rates are limited to positive values. (b)
- Determine a missing value in a ratio table that represents a proportional relationship between two quantities using a unit rate. Unit rates are limited to positive values. (b)
- Determine whether a proportional relationship exists between two quantities, when given a table of values or a verbal description, including those represented in a practical situation. Unit rates are limited to positive values. (c)
- Determine whether a proportional relationship exists between two quantities given a graph of ordered pairs. Unit rates are limited to positive values. (c)
- Make connections between and among multiple representations of the same proportional relationship using verbal descriptions, ratio tables, and graphs. Unit rates are limited to positive values. (d)

The following graph shows the relationship between the number of times a heart beats and the number of seconds that has passed while a cat is at rest.



Does this graph represent a proportional relationship? Explain your reasoning.

7.10 The student will

a) determine the slope, m, as rate of change in a proportional relationship between two quantities and write an equation in the form $y = mx$ to represent the relationship;

b) graph a line representing a proportional relationship between two quantities given the slope and an ordered pair, or given the equation in $y = mx$ form where m represents the slope as rate of change;

c) determine the y-intercept, b, in an additive relationship between two quantities and write an equation in the form $y = x + b$ to represent the relationship;

d) graph a line representing an additive relationship between two quantities given the y-intercept and an ordered pair, or given the equation in the form $y = x + b$, where b represents the y-intercept; and

e) make connections between and among representations of a proportional or additive relationship between two quantities using verbal descriptions, tables, equations, and graphs.

Brainstorm what you think students will be asked to do based on this standard.

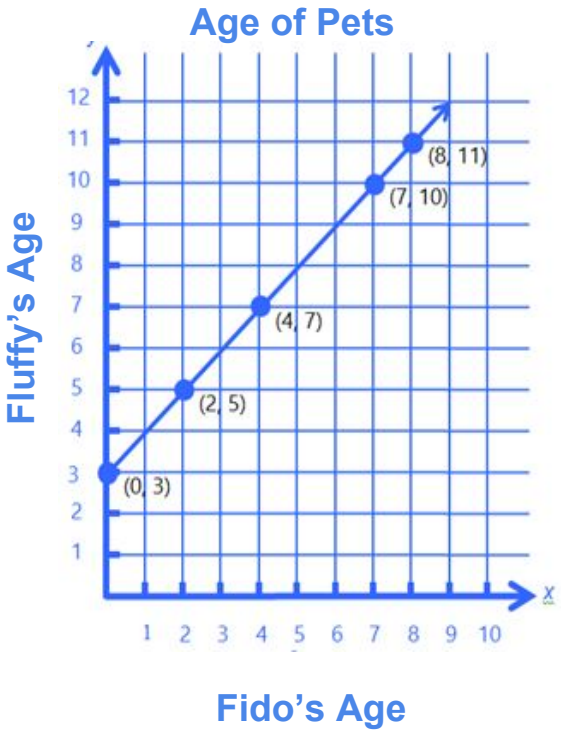
SOL 7.10

Essential Knowledge and Skills

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Determine the slope, *m*, as rate of change in a proportional relationship between two quantities given a table of values or a verbal description, including those represented in a practical situation, and write an equation in the form $y = mx$ to represent the relationship. Slope will be limited to positive values. (a)
- Graph a line representing a proportional relationship, between two quantities given an ordered pair on the line and the slope, *m*, as rate of change. Slope will be limited to positive values. (b)
- Graph a line representing a proportional relationship between two quantities given the equation of the line in the form $y = mx$, where *m* represents the slope as rate of change. Slope will be limited to positive values. (b)
- Determine the *y*-intercept, *b*, in an additive relationship between two quantities given a table of values or a verbal description, including those represented in a practical situation, and write an equation in the form $y = x + b$, $b \neq 0$, to represent the relationship. (c)
- Graph a line representing an additive relationship ($y = x + b$, $b \neq 0$) between two quantities, given an ordered pair on the line and the *y*-intercept (*b*). The *y*-intercept (*b*) is limited to integer values and slope is limited to 1. (d)
- Graph a line representing an additive relationship between two quantities, given the equation in the form $y = x + b$, $b \neq 0$. The *y*-intercept (*b*) is limited to integer values and slope is limited to 1. (d)
- Make connections between and among representations of a proportional or additive relationship between two quantities using verbal descriptions, tables, equations, and graphs. (e)

Fluffy is 3 years older than her brother, Fido.. A graph of relationship between their ages is shown below:



What equation represents the additive relationship shown in the graph above?

8.16 The student will

a) recognize and describe the graph of a linear function with a slope that is positive, negative, or zero;
b) identify the slope and y-intercept of a linear function, given a table of values, a graph, or an equation in $y = mx + b$ form;
c) determine the independent and dependent variable, given a practical situation modeled by a linear function;
d) graph a linear function given the equation in $y = mx + b$ form; and
e) make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.

Brainstorm what you think students will be asked to do based on this standard.

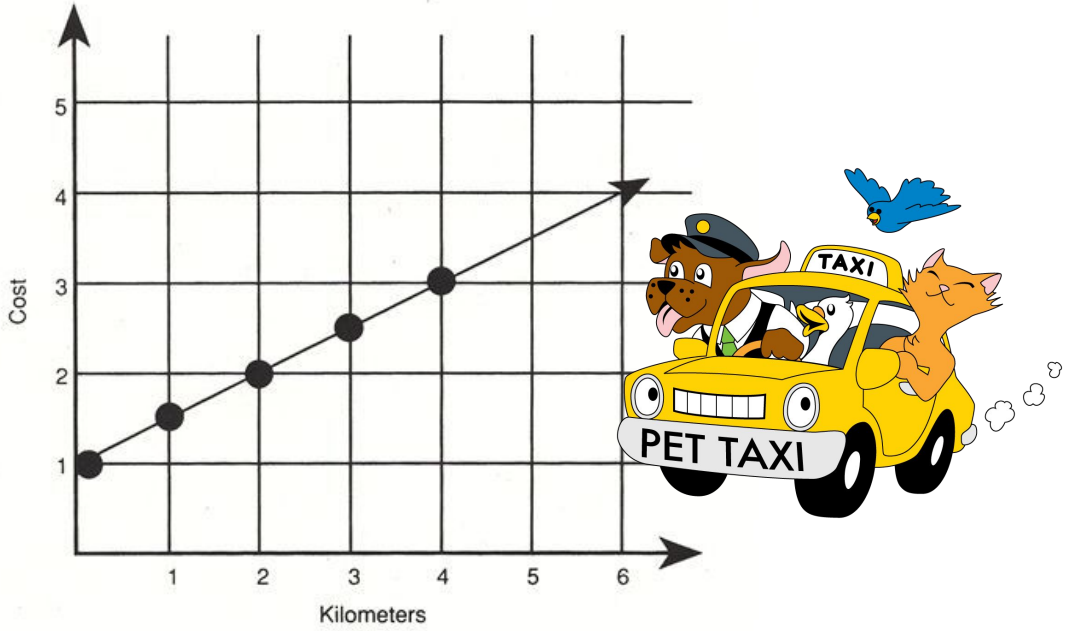
SOL 8.16

Essential Knowledge and Skills

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Recognize and describe a line with a slope that is positive, negative, or zero (0). (a)
- Given a table of values for a linear function, identify the slope and *y*-intercept. The table will include the coordinate of the *y*-intercept. (b)
- Given a linear function in the form $y = mx + b$, identify the slope and *y*-intercept. (b)
- Given the graph of a linear function, identify the slope and *y*-intercept. The value of the *y*-intercept will be limited to integers. The coordinates of the ordered pairs shown in the graph will be limited to integers. (b)
- Identify the dependent and independent variable, given a practical situation modeled by a linear function. (c)
- Given the equation of a linear function in the form $y = mx + b$, graph the function. The value of the *y*-intercept will be limited to integers. (d)
- Write the equation of a linear function in the form $y = mx + b$ given values for the slope, *m,* and the *y*-intercept or given a practical situation in which the slope, *m*, and *y*-intercept are described verbally. (e)
- Make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs. (e).

The following graph shows the relationship between the cost a taxicab driver charges and the kilometers traveled.



What is the slope of this graph and what does it represent?

What is the y-intercept of this graph and what does it represent?

digging DEEPER

Summer PD

Proportional Reasoning

Sarah is going to an amusement arcade to play games with her friends. Sarah's arcade charges $3 per game and no entrance fee to the arcade. Kayla is going to a different arcade that charges an entrance fee of $4 plus $1 per game. The tables below represent the cost per number of games played for Sarah and Kayla.

Sarah

# of games	Total Cost
1	$3
2	$6
3	$9
4	$12

Kayla

# of games	Total Cost
1	$5
2	$6
3	$7
4	$8

Given that both girls will pay $6 for two games, do the tables represent the same relationship?

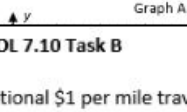
VDOE Tasks

SOL 8.16 Task B

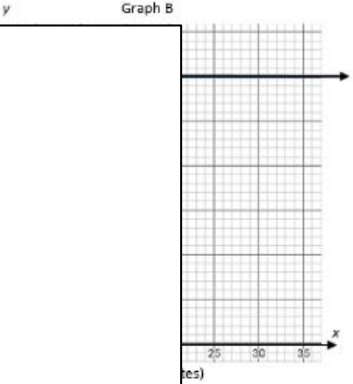
Sam works downtown and lives outside the city. He is driving at a constant rate of speed from his home to work.

1. Which of the following graphs could best represent his trip, if x represents the total time he has been driving and y represents the distance he has travelled?

Graph A



Graph B



SOL 7.10 Task B

…ver charges a pick-up fee of $3 and an additional $1 per mile travelled.

1. Complete the table below.

Number of Miles (x)	Total Cost (y)
1	
2	

…ur reasoning.

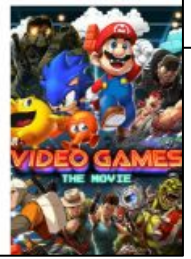
SOL 6.12 Task B

Sam would like to buy a video game that costs $27. Because Sam has not saved any money, his parents are willing to pay him for chores completed around the house. They agree to pay Sam $3 for every 2 chores he completes but will also pay him at the same rate for completing single chores.

1. Does the situation above represent a proportional relationship? Explain your thinking.

2. Complete the table below to show how many chores Sam would have to do in order to save enough money to buy the game.

chores	1	2	4		9	
money earned		$3		$12		$27



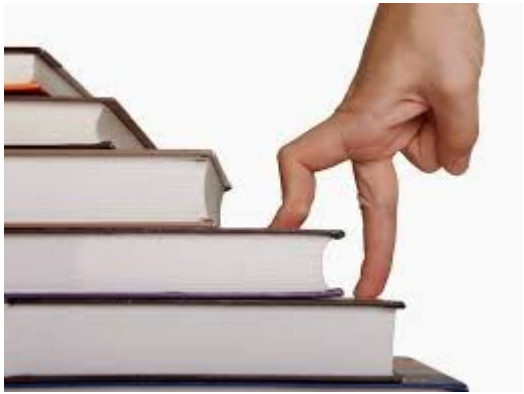
Next Activity...

Work in grade level groups

- Create tasks or assessment questions for 6.12, 7.10 or 8.16
- Identify the bullet(s) to which the task applies
- Post your item(s) in the Google folder
- Each group will have a few minutes at the end to share their work

Second Step...

Planning a unit and resources for Math 6



Some conversations we've had planning Math 6

- Unit rate
- Equivalent ratios versus equivalent fractions
- Being careful with problems being too much like solving a proportion
- Needing experience graphing quadrant 1 prior to the unit
- Continuous versus discrete graphs
- Moving into more thinking about the relationship between 2 different sets of data rather than part/part, part/whole
- Ask ratios in both directions
- Being purposeful in asking y/x ratios when using tables

Math 6 Unit (In progress…)

Name: _____ Date:_____ Block:_____ E#

Equivalent Ratio Exploration

Record the color of your cubes and the number of cubes for each color.

	Cube Color	Number of Cubes
Color 1		
Color 2		
Color 3		
Total number of cubes:		

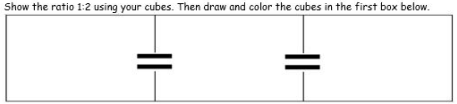
1) Write each ratio in simplest form:

Color 1 to color 2: _____

Color 3 to the total: _____

Color 2 to color 3: _____

2) Show the ratio 1:2 using your cubes. Then draw and color the cubes in the first box below.



3) Show the ratio 4:6 using your cubes. Then draw and color the cubes in the middle box below.

4) Show the ratio 5:5 using your cubes. Then draw and color the cubes in the third box below.

Equivalent Ratios

Part A: Fractions

1) $\frac{\square}{\square} = \frac{\square}{\square} = \frac{\square}{\square}$

2) $\frac{\square}{\square} = \frac{\square}{\square} = \frac{\square}{\square}$

3) $\frac{\square}{\square} = \frac{\square}{\square} = \frac{\square}{\square}$

4) $\frac{\square}{\square} = \frac{\square}{\square} = \frac{\square}{\square}$

Part B: With a colon

5) _____ : _____ = _____ : _____ = _____ : _____

6) _____ : _____ = _____ : _____ = _____ : _____

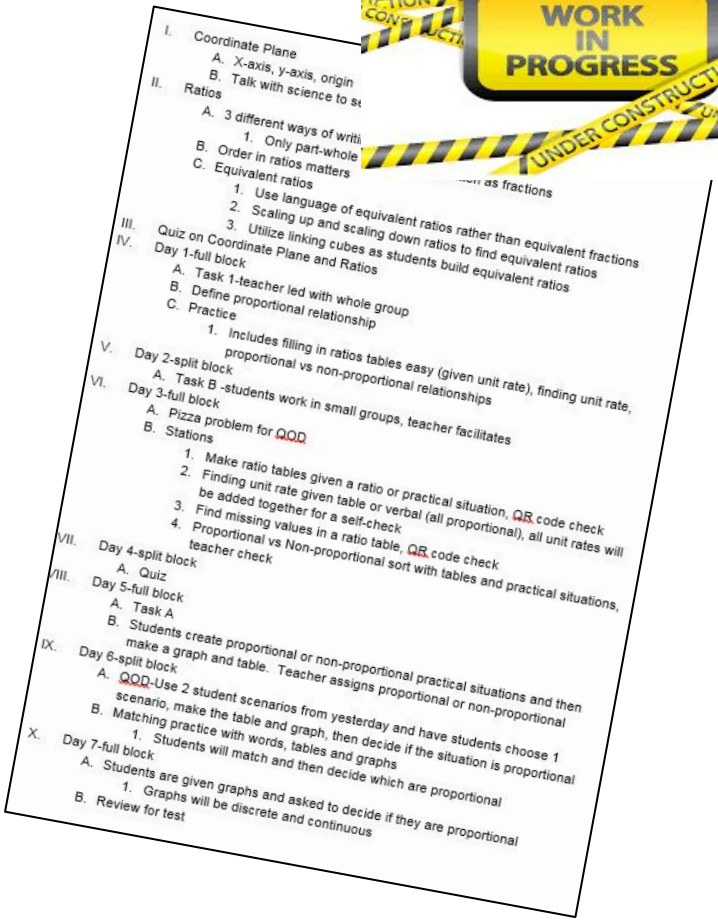
7) _____ : _____ = _____ : _____ = _____ : _____

Part C: With words

8) In the cookie jar, the ratio of chocolate chip to peanut butter is 3:2. What are possible combinations of cookies in the jar?

9) In Sam's class, the ratio of girls to boys is 4:5. Could his classroom have 15 girls and 12 boys? Why or why not?

10) The ratio of elephants to giraffes in a zoo is 2:5. If there are 35 animals in the zoo, how many elephants and giraffes are there?



The Gears Are Moving

- Practice with Proportional Reasoning
- Station Activity
- Desmos Sort

Desmos Activity

Visit http://student.desmos.com

Link to activity

https://teacher.desmos.com/activitybuilder/custom/59cd5cfecc3fa4139c8f7575

Other thoughts...

Finding contexts for Math 7 for additive relationships with a slope of 1

Math 7 teachers will need to resist the urge to combine the multiplicative and additive relationships

Finding contexts for zero and negative slopes in Math 8

Math 8 discussion y = 5 versus x = 5

Developing Math 7 and Math 8 resources

Which One Doesn’t Belong?

Thank you for coming!

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